DIRECT TENSION INDICATORS Misc: 440-2 **(10-20-00)**

1.0 GENERAL

Direct tension indicators shall be used on all AASHTO M164 high strength bolt connections on bridges. Plan Note

Direct tension indicators shall conform to this Special Provision, the requirements of ASTM F959 and the manufacturer's recommendations. 1072-7(B) & 440-10(C)6

2.0 MATERIAL REQUIREMENTS

~~The direct tension indicator material, manufacturing process, performance requirements, workmanship and certification requirements shall conform to the requirements of ASTM F959.~~

For Type 3 high strength bolts, the direct tension indicators shall be mechanically galvanized to AASHTO M298 Class 50, and then baked epoxy shall be applied to a thickness of 1 mil minimum. Direct tension indicators manufactured from material conforming to the requirements applicable to AASHTO M164, Type 3 bolts need not be mechanically galvanized or epoxy coated. 1072-7(C) C4

For plain Type 1 high strength bolts, the direct tension indicators shall be plain or mechanically galvanized to AASHTO M298 Class 50.

For galvanized Type 1 high strength bolts, the direct tension indicators shall be mechanically galvanized to AASHTO M298 Class 50.

3.0 TEST DOCUMENTS

1072-7(D) D3

~~The Contractor shall furnish to the Engineer a copy of the manufacturer's test report for each lot of direct tension indicators to be incorporated into the project.~~ The tests shall have been performed by the manufacturer according to the requirements of ASTM F959. ~~Each test report shall include the lot number of the indicators, manufacturer's name~~, tension load when indicators were tested, gap clearance, nominal size, coating thickness, ~~date tested, and name and location of the company that performed the tests.~~

1072-7(A)

The Contractor shall furnish to the Engineer a copy of the manufacturer's instructions for installing the direct tension indicators before installation begins along with at least one metal feeler gage for each container of direct tension indicators shipped.

The lot number on the containers of direct tension indicators shall be for the same lot number tested as indicated on the test documents.

440-10(C)6

4.0 SAMPLES REQUIRED FOR TESTS BY THE DEPARTMENT

440-10(C)6

The Contractor shall furnish to the Engineer three samples of load indicating washers from each lot number, each size and type for tests and two each of the metal feeler gages required for performing the tests.

5.0 INSTALLATION

The Contractor shall install the direct tension indicators in strict compliance with the manufacturer's written instructions.

It is anticipated that the direct tension indicator will normally be installed under the bolt head. If it is necessary to install the direct tension indicator under the nut, or if the bolt head must be turned, additional hardened washers shall be installed in accordance with the manufacturer's instructions.

The Contractor shall have a tension indicating device on the project for determining the tension imposed on a fastener when the protrusions on direct tension indicator have been properly compressed.

440-10(C)6

Three samples from each lot of direct tension indicators shall be tested in the presence of the Engineer. The minimum bolt tension achieved shall be 5% greater than that required by Table 440-1 of Article 440-10 of the Standard Specifications.

Direct tension indicators shall not be substituted for the hardened steel washers required with short slotted or oversized holes, but may be used in conjunction with them.

The initial installation of the direct tension indicators shall be to a snug tight condition as specified in Article 440-10, Paragraph (C) (3) of the Standard Specifications. After the initial tightening, the fasteners shall be fully tightened, as recommended by the manufacturer of the direct tension indicators, beginning at the most rigid part of the joint and continuing toward its free edges.

The wrench used by the Contractor in tightening fasteners containing direct tension indicators shall be of the type and capacity recommended by the manufacturer and shall be clean and lubricated. The air supply and hoses shall be in good condition and provide air pressure of at least 100 psi at the wrench.

Any heating of structural steel required for corrections in the vicinity of fasteners shall be performed before fasteners or direct tension indicators are installed.

6.0 INSPECTION

Correct tightening of bolts will be inspected by the Engineer by inserting a 0.005 inch thickness feeler gauge into the openings between adjacent flattened protrusions of the direct tension indicator. Correct tensioning will be obtained when the number of spaces for which the gage is refused is equal to or greater than the value shown in the table below.

440-10(D)

440-10(D)

Number of Spaces in Washer	Number of Spaces Gage is Refused*
4	2
5	3
6	3
7	4
* The gage shall be refused in all spaces when the direct tension indicator is used under the turned element.	

440-10(D)

Bolts are not to be tightened to a no visible gap condition.

Inspections of the installations will be accomplished by the use of metal feeler gages provided by the Contractor. At least 10%, but no less than two, of the bolts in each connection will be inspected with feeler gages. Additionally, all remaining bolts in each connection shall be visually inspected for proper tightening.

The Contractor's procedure for tightening the fasteners shall insure that the part of the fastener being restrained from turning does not rotate during the tightening process.

440-10(C)6

The Contractor shall insure that no portion of the direct tension indicator protrusions is accidentally partially flattened before installing in the structural steel joints.

Direct tension indicators shall not be reused. If it becomes necessary to loosen a bolt previously tensioned, the direct tension indicator shall be discarded and replaced.

7.0 BASIS OF PAYMENT

~~No separate payment will be made to the Contractor for supplying and installing direct tension indicators. The indicators are considered incidental to the work and shall be included in the contract price bid for the various pay items.~~